DOE Office of Petroleum Reserves – Strategic Unconventional Fuels

Fact Sheet: Carbon Management for Strategic Unconventional Resources

The Issues

- Carbon dioxide (CO_2) in the earth's atmosphere has been implicated in global warming.
- The use of fossil fuels for the energy needs of society produces emissions of CO_2.
- Production of unconventional fuels (oil shale, coal to liquids, heavy oil) produces more CO_2 than is produced when using conventional petroleum; the issues are:
  - Where CO_2 is produced in the process,
  - The concentration of the produced CO_2, and
  - The cost of capturing and sequestering it.
- Technologies are being developed and demonstrated for more efficiently capturing, concentrating, and storing or utilizing CO_2 generated in energy production processes.
- Global and national assessments of carbon sequestration potential show vast storage capacity.

Carbon Dioxide Sequestration and Utilization

- Carbon dioxide may be sequestered in deep saline formations, depleted natural gas reservoirs, depleted oil reservoirs, deep unmineable coal seams, deep saline-filled salt formations, salt caverns, and organic shales.[1]
- In April, 2007, the U.S. DOE published the first edition of the Carbon Sequestration Atlas of the United States and Canada[2]. In the Atlas, the seven regional federal/state sequestration partnerships estimate that at least 3,500 billion tons of CO_2 may be sequestered in oil and gas reservoirs, unmineable coal seams, and deep saline formations. The sequestration partnerships estimate over 1,000 years of total sequestration potential in the United States.
- The Battelle Global Energy Technology Strategy Program in 2006 reported that "assuming that other advanced energy technologies are developed and deployed along with carbon capture and storage systems, this potential storage capacity should be more than enough to address CO_2 storage for at least this century."[3]
- Enhanced oil recovery utilizing CO_2 (CO_2-EOR) is a proven technique with a long history in United States oil fields. The federal/state sequestration partnerships estimate that 89 billion barrels of oil could be recovered and 20 billion metric tons of CO_2 could be utilized using current CO_2-EOR technologies. Ultimately, as much as five times as much CO_2 could be stored and three times as much oil could be recovered using advanced technology.[4]
- Sequestration and CO_2-EOR opportunities are widespread but are not found in every locale. An extensive pipeline system may ultimately be required. CO_2 transport via pipeline is proven technology and in use in oilfields in the United States. Today, approximately 3,000 miles of dedicated CO_2 pipeline deliver CO_2 to commercial EOR projects in North America.[5]

Carbon Dioxide Sequestration Issues

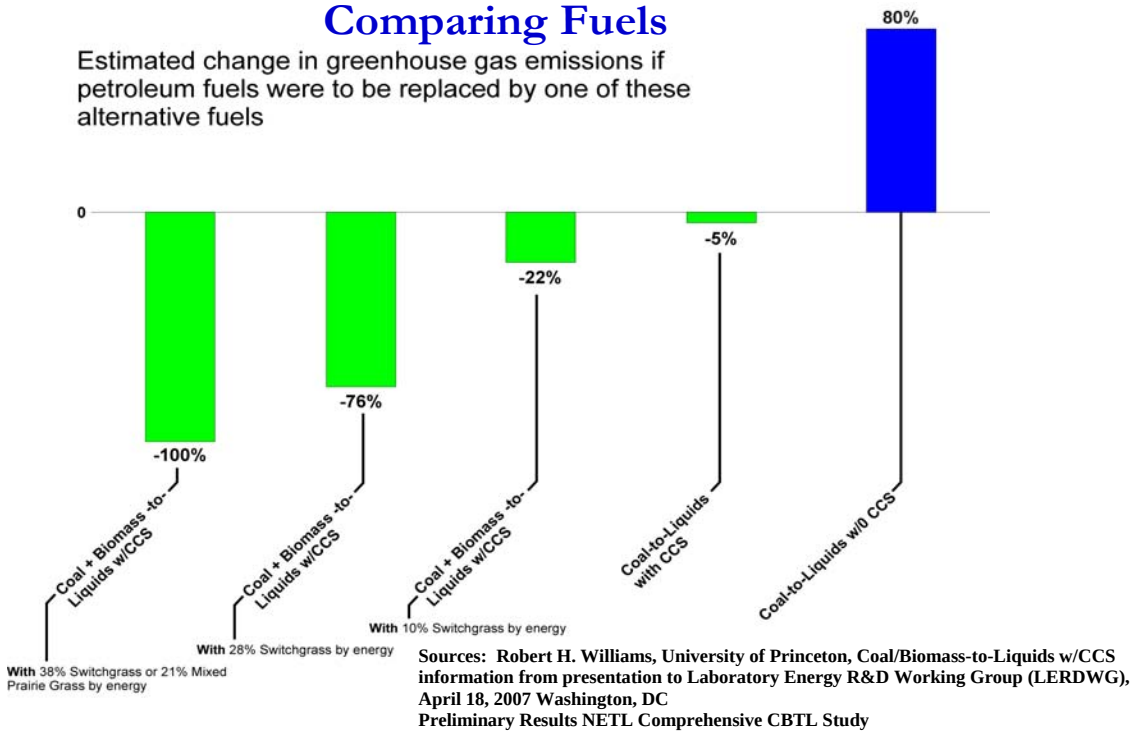
- The Massachusetts Institute of Technology in 2007 identified the major issues relating to sequestration as:
  - Sufficient capacity for storage;
  - Understanding of storage mechanisms;
  - Establishing a process to certify injection sites;
  - Monitoring and verification of the movement of subsurface CO_2;
  - Probability of and risks associated with leakage.
- MIT concluded that "there do not appear to be unresolvable open technical issues underlying these questions" and that "the hurdles to answering these technical questions well appear manageable and surmountable."[6]
- Sequestration issues also include legal questions relating to (a) ownership of pore space, (b) transfers of ownership and liability, (c) competition between mineral rights and storage rights, carbon dioxide reduction credit allocation, and (d) territorial and constitutional jurisdiction.[7]

Carbon Dioxide Emissions Technology

- The Fischer-Tropsch process utilized in production of coal-to-liquids (CTL) and in co-production of electricity and transportation fuels, hydrogen, or chemicals via Integrated

Gasification Combined Cycle (IGCC) requires separation of CO_2 from the synthesis gas, and consequently produces a concentrated stream of carbon dioxide at low cost that may be sequestered or utilized.

- Shale oil, heavy oil, and oil from tar sands will likely be centralized in large manufacturing facilities in which concentrated streams of carbon dioxide can be captured for beneficial use or sequestration.
- Because production of transportation fuels from all types of unconventional energy resources will either employ or produce large amounts of electricity, development of generation technologies for efficiently capturing carbon dioxide is a major consideration in development of unconventional fuels industries, as well for the national energy mix in general.
- Government and industry partnerships are developing a wide range of technologies for reducing CO_2 emissions by increasing the efficiency of electricity generation that range from near-immediate CO_2 emissions reductions of 7 - 8 percent from power plants that operate at supercritical temperatures and pressures to near-term (7 – 10 years) reductions of 20 - 30 percent by ultra supercritical power plants and longer-term (10 years or more) near total reductions from IGCC and sequestration.[8]
- Government and industry are developing a wide range of technologies for reducing CO_2 emissions in coal gasification and production of transportation fuels from coal. The chart below shows that production of liquid transportation fuels from coal utilizing processes that sequester CO_2 can result in no more, and possibly less, CO_2 emissions as conventional petroleum fuel. The addition of biomass to the coal in the gasification stage of CTL production along with carbon capture and sequestration can dramatically reduce the amount of CO_2 emissions.



Sources: Robert H. Williams, University of Princeton, Coal/Biomass-to-Liquids w/CCS information from presentation to Laboratory Energy R&D Working Group (LERDWG), April 18, 2007 Washington, DC
Preliminary Results NETL Comprehensive CBTL Study

References

[1] Battelle. Global Energy Technology Program. April, 2006. p. 17
[2] DOE. National Energy Technology Laboratory. Carbon Sequestration Technology Roadmap and Program Plan, 2007.
[3] Battelle. Global Energy Technology Program. April, 2006. p. 34
[4] DOE. National Energy Technology Laboratory. Carbon Sequestration Technology Roadmap and Program Plan, 2007. p.26
[5] Battelle. Global Energy Technology Program. April, 2006. p. 35
[6] Massachusetts Institute of Technology. The Future of Coal: Options for a Carbon-Constrained World. 2007. p 43
[7] Stefan Bachu. Address to DOE Sixth Annual Conference on Carbon Capture and Sequestration. Pittsburgh. May 10, 2007.
[8] National Coal Council. Technologies to Reduce or Capture and Store Carbon Dioxide Emissions: A Report to the Secretary of Energy. 2007.